INTERNATIONAL STANDARD

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Tissue paper and tissue products —

Part 11: Determination of wet ball burst strength

Papier tissue et produits tissues —

Partie 11: Détermination de la résistance à l'éclatement à l'état humide, méthode à la balle

Reference number
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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12625-11 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

ISO 12625-11 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 172, *Pulp, paper and board*, in collaboration with Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods for quality specifications for paper and board*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 12625 consists of the following parts, under the general title *Tissue paper and tissue products*:

— *Part 1: General guidance on terms;*

— *Part 3: Determination of thickness, bulking thickness and apparent bulk density;*

— *Part 4: Determination of tensile strength, stretch at break and tensile energy absorption;*

— *Part 5: Determination of wet tensile strength;*

— *Part 6: Determination of grammage;*

— *Part 7: Determination of optical properties – Measurement of brightness and colour;*

— *Part 8: Water-absorption time and water-absorption capacity; basket-immersion test method;*

— *Part 9: Determination of ball burst strength;*

— *Part 11: Determination of wet ball burst strength;*

— *Part 12: Determination of tensile strength of perforated lines – Calculation of perforation efficiency.*

Introduction

This part of ISO 12625 is applicable to tissue papers and tissue products. In principle, application to other types of paper is possible, but is not covered by this part of ISO 12625.

Tissue paper and tissue products —

Part 11: Determination of wet ball burst strength

1 Scope

This part of ISO 12625 specifies a test method for the determination of the resistance to mechanical penetration (ball burst strength procedure) of tissue paper and tissue products after wetting.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 186, *Paper and board — Sampling to determine average quality*

ISO 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 12625-1, *Tissue paper and tissue products — Part 1: General guidance on terms*

ISO 12625-9:2005, *Tissue paper and tissue products — Part 9: Determination of ball burst strength*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12625-1 and the following apply.

3.1
bursting force
F_D
maximum force, that a test piece of a tissue paper or tissue product can withstand under the test conditions, applied at a 90° angle to its surface

[ISO 12625-9:2005]

NOTE 1 The bursting force is expressed in millinewtons (mN).

NOTE 2 ISO 12625-9:2005 measures the bursting force of the test piece in the dry condition and uses an inner clamping diameter of 89 mm. At the next revision it is intended to change this inner diameter to 50 mm.

3.2
wet bursting force
F_W
maximum force, that a wetted test piece of a tissue paper or tissue product can withstand under the test conditions, applied at a 90° angle to its surface

NOTE The wet bursting force is expressed in millinewtons (mN).

3.3
wet burst index
X_W
wet bursting force of the tissue paper or tissue product divided by the grammage of the conditioned sample determined by the standard method of test

NOTE The wet burst index is expressed in millinewton square metre per gram ($mN \cdot m^2/g$).

3.4
wet burst retention
W_R
ratio, expressed as a percentage, of the burst strength of the wet tissue paper or wet tissue product to the burst strength of the same tissue paper or tissue product in the dry and conditioned state

NOTE This definition is similar to the definition of wet tensile strength retention; see ISO 12625-5:2005.

4 Principle

A test piece of tissue paper or tissue product is rigidly clamped at the periphery between two concentric annular rings, then wetted with deionized water and submitted to a perpendicular force until penetration, applied by a ball of a hard, non-deformable, material moving at a constant speed.

5 Reagents

5.1 Deionized water, with a conductivity ≤ 0,25 mS/m at 25°C, in accordance with ISO 14487. The water temperature should be maintained during the test at the temperature used for conditioning and testing.

6 Apparatus

6.1 General

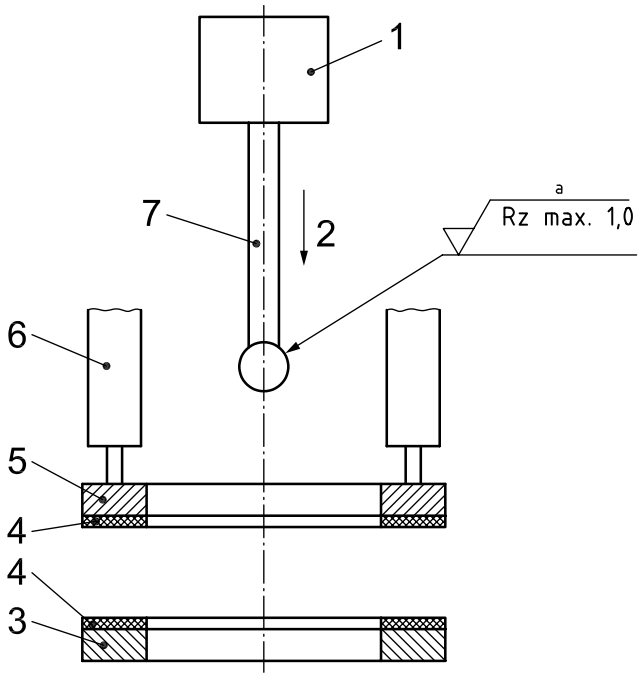
The apparatus shall be placed on a horizontal surface, free from externally induced vibrations.

6.2 Clamping system

The clamping system is designed to clamp the test piece firmly and uniformly between two concentric annular plane, parallel surfaces. The clamping rings can be activated mechanically or pneumatically.

The clamping pressure shall be sufficient to prevent slippage during the test, without damaging the test pieces.

The clamping surfaces of the clamping rings are coated with a commercial grade of a band made of rubber material, typically 1,0 mm to 2,0 mm thick, having an IRHD hardness (International Rubber Hardness Degree) of 70 IRHD to 85 IRHD. The inner edges of the coated band shall be coincident with the inner diameter of the clamping rings and be at least 12,5 mm wide. The internal diameter of the two concentric rings shall be (50,0 ± 0,2) mm. For an example of a pneumatic clamping system, see Figure 1.



Legend

1 load cell
2 travel
3 stationary ring
4 suitable band made of rubber (e. g. chloroprene rubber)
5 movable centre-ring
6 pneumatic cylinder
7 probe

a Polished ball.

Figure 1 — Principle of the clamping system, pneumatic fixture

6.3 Penetration system

The penetration (burst) system shall consist of a spherical ball attached to a rod designed to transmit the force applied to the ball. The penetration ball shall be made of highly polished stainless steel and shall have the following dimensions:

— diameter: (16 ± 0,2 mm);

— sphericity: better than 1 µm.

The penetration ball shall be centred with the annular clamps. It is permanently attached to the end of a solid hard rod designed to transmit the force applied to the ball.

6.4 Force measuring system

The force measuring system shall measure the loads with a class of machine range of 1 or better and shall be calibrated and verified in accordance with the requirements of ISO 7500-1.

The load cell system shall have a measuring range of 0,1 N to 15 N.

The readout system shall have a display that shows the maximum force at burst.

6.5 Drive mechanism

The drive mechanism shall consist of a static uniaxial testing machine with a suitable mechanism for moving either the clamping system or the penetration system so that they approach each other at a constant rate in a direction perpendicular to the clamping system plane.

The penetration test speed shall be (125 ± 5) mm/min.

6.6 Water application system

A water application system shall be either a pipette or any automatic volumetric water application system like dosimat ®[1)] with a volume accuracy of (5,0 ± 0,1) ml and capable of delivering 5 ml water within 3 s to 4 s.

7 Sampling

If the tests are being made to evaluate a lot, the sample shall be selected in accordance with ISO 186.

If the tests are being made on another type of sample, make sure that the specimens taken are representative of the sample.

When sampling finished roll products, possible presence of adhesives or mechanical damage shall be avoided. Therefore, exclude at least the first and the last six windings of the roll.

8 Conditioning

8.1 General

Condition the samples according to ISO 187, unless otherwise agreed between the parties concerned, and keep them in the standard atmosphere throughout the test.

8.2 Rapid ageing (curing)

The wet strength of tissue paper is frequently enhanced by addition of a wet strength agent. A rapid ageing with heat is frequently used to develop the maximum wet strength that a tissue paper or tissue product will achieve after a period of natural ageing at ambient conditions which may vary from a few days to several weeks, depending on the wet strength agent used.

NOTE The decision on whether or not to use rapid ageing will be determined by the user of this part of ISO 12625, based upon the information about the tissue paper or tissue product sample being tested. Rapid ageing is not a requirement of this part of ISO 12625, but is an allowed option. There is no rule for determining whether to rapid age or not, but the following principles are generally applied.

8.2.1 Production test pieces, which have not left the manufacturing environment, are generally rapid aged. To rapid age a tissue paper or tissue product, it is recommended to heat in air at (80 ± 2) °C for 30 min.

After heating, condition the test piece in a standard atmosphere at (23 ± 1) °C and (50 ± 2) % relative humidity for at least 1 h prior to testing.

For production inspections where data must be available quickly, rapid ageing conditions of (105 ± 2) °C for 15 min may be used.

8.2.2 Test pieces which have been delivered to the market are generally not rapidly aged.

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1) Dosimat is a trade name of a product commercially available. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

9 Preparation of test pieces

9.1 General

Test pieces shall be free of areas containing creases, dirt or visible damage.

9.2 Preparation of test pieces

Test pieces shall be larger than the clamping area of the testing machine. Prepare at least 10 test pieces of the sample conditioned as described in Clause 8.

9.2.1 Base paper that has not been converted shall be tested as a single ply, unless otherwise agreed between the parties concerned.

9.2.2 For tissue products, testing shall be carried out on the product as received, regardless of the number of plies.

9.2.3 Cut at least 10 test pieces which are larger than the clamping area of the clamping system (6.2).

NOTE Toilet paper is frequently produced in rolls of perforated sheets. In testing such toilet tissue it is convenient to remove a specimen consisting of three connected sheets. The outer two sheets should be used for moving the test piece into the clamping system, while the middle sheet is subjected to the test.

10 Procedure

10.1 Turn on the power of the testing machine at least 30 min prior to testing.

10.2 Clamp the conditioned test piece top side up without applying any tension to it. If the top side cannot be identified, ensure that the same side of all test pieces is clamped uppermost.

10.3 After clamping the test piece in the clamping device, adjust the distance between the lowest part of the penetration system and the top surface of the test piece to (25 ± 0,5) mm. Set the rate at which the penetration system and test piece approach each other to (125 ± 5) mm/min.

10.4 Carry out the wetting procedure of the test piece by adding 5 ml of deionized water in 3 s to 4 s using a pipette or an automatic volumetric addition system (e.g. dosimat®[2)]).

When adding the deionized water, the delivery tip of the system touchs the upper surface of the penetration ball (6.3), so that the water drips from the ball onto the test piece.

10.5 Begin the test immediately after adding the deionized water. By the use of the travel rate, a residence time of 15 s to 16 s results.

10.6 Record the maximum value of the force at burst as the bursting force F_W to three significant figures.

10.7 Dry the clamping and penetration systems.

10.8 Perform the above sequence with the remaining pieces until at least 10 valid results are obtained.

11 Calculation

Determine the average value $\bar{F}_W$ of the wet bursting force for the 10 test pieces.

2) See the footnote on page 4.

If required, determine the wet burst index, X_W, expressed in millinewton square metre per gram [mNm^2/g] using Equation (1):

$$X_W = \frac{\bar{F}_W}{g} \quad (1)$$

where

$\bar{F}_W$ is the mean wet bursting force, expressed in millinewtons [mN];

g is the grammage of the sample, expressed in grams per square metre [g/m^2].

If required, determine the wet burst retention, W_R, as a percentage using Equation (2):

$$W_R = \frac{\bar{F}_W \times 100}{\bar{F}_D} \quad (2)$$

where

$\bar{F}_W$ is the mean wet burst force of the wetted tissue, expressed in millinewtons [mN];

$\bar{F}_D$ is the mean burst force of the conditioned tissue sample in millinewtons [mN], determined according to ISO 12625-9.

NOTE F_D is measured according to ISO 12625-9 with a clamping ring diameter of 89 mm. Ring tests have not shown any significant difference in results between measurements with a 50 mm and 89 mm ring diameter.

12 Test report

The test report shall include the following information:

a) a reference to this part of ISO 12625;

b) date and place of testing;

c) complete identification of the sample tested;

d) the mean wet bursting force $\bar{F}_W$, in millinewtons, to three significant figures, the standard deviation and the maximum and minimum values measured;

e) if required, the wet burst index X_W, in millinewton square metre per gram, to three significant figures;

f) if required, the wet burst retention W_R, in percent, rounded to one decimal place;

g) whether the test piece was rapid aged, and under which conditions;

h) any departure from this part of ISO 12625 and other circumstances that may have affected the test results.

Annex A
(informative)

Precision

In December 2009, an international interlaboratory test was performed on six converted tissue products by 11 different laboratories according to this part of ISO 12625.

The repeatability and reproducibility limits reported are estimates of the maximum difference which should be expected in 19 of 20 instances, when comparing two test results for material similar to those described under similar test conditions. These estimates may not be valid for different materials or different test conditions.

The results are shown in Table A.1.

NOTE Repeatability and reproducibility limits are calculated by multiplying the repeatability and reproducibility standard deviations by 2,77, where $R = 1{,}96\sqrt{2} \cdot s$.

A.1 General

Table A.1 — Interlaboratory results

Sample	Mean wet bursting force $\bar{F}_W$ mN	Number of laboratories p	Repeatability standard deviation s	Repeatability limit r	Repeatability coefficient of variation $C_{V,r}$ %	Reproducibility standard deviation s_R	Reproducibility limit R	Reproducibility coefficient of variation $C_{V,R}$ %
TAD household towel 2 plies	4262	11	373	1035	8,76	479	1327	11,23
TAD bathroom tissue 2 plies	410	10	39	108	9,49	68	189	16,65
TAD kitchen towel lotioned	3783	11	397	1100	10,49	530	1470	14,02
Conventional bathroom tissue 4 plies	116	10	17	48	14,77	44	122	37,94
Conventional household towel 2 plies	1448	11	266	739	18,40	278	771	19,21
Handkerchief 4 plies	1324	09	176	488	13,28	182	504	13,74

Annex B
(informative)

Adaptor

Current instruments have clamp devices with inner ring diameters of 89 mm. By using adaptors for the clamping system, the clamps can still be used for dry ball burst according to ISO 12625-9:2005.

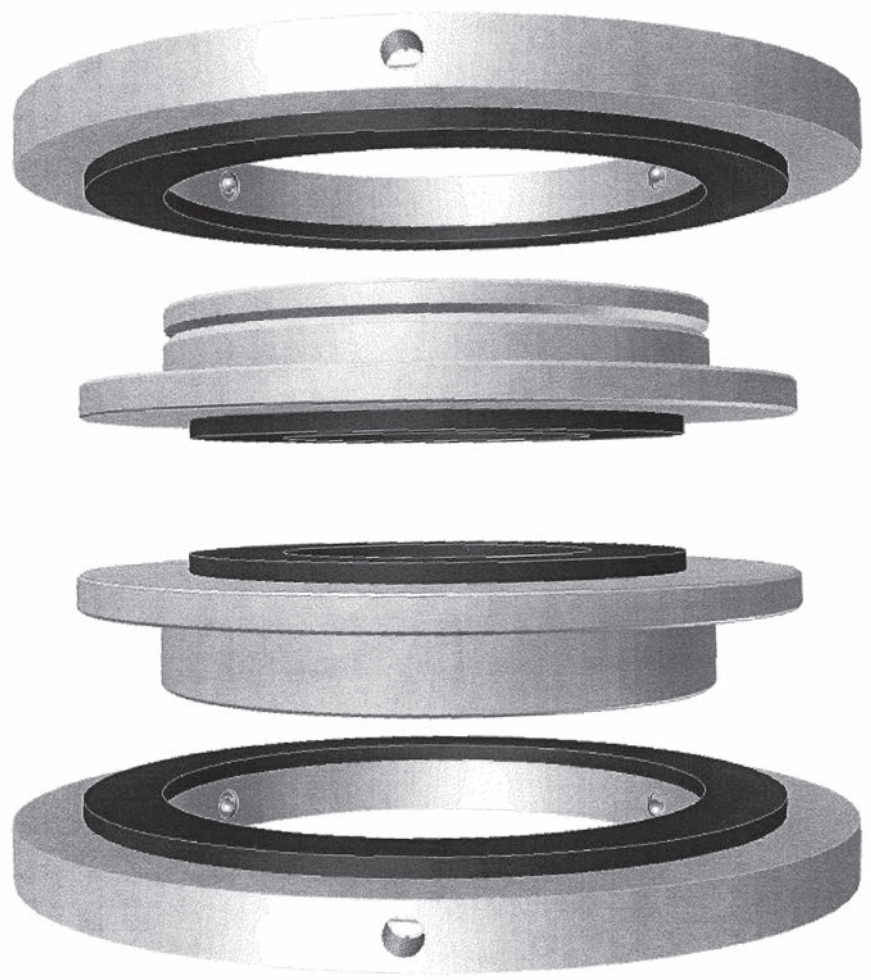

Figure B.1 — Example for reducing rings

Bibliography

[1] ISO 287, *Paper and board — Determination of moisture content of a lot — Oven-drying method*

[2] ISO 1302, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

[3] ISO 12625-5:2005, *Tissue paper and tissue products — Part 5: Determination of wet tensile strength*

[4] ISO 12625-6, *Tissue paper and tissue products — Part 6: Determination of grammage*

[5] ISO 15755, *Paper and board — Estimation of contraries*

[6] TAPPI, T570 pm-oo, *Resistance to mechanical penetration of sanitary tissue parts (ball burst procedure)*

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